What is claimed is:

1. An apparatus comprising:

a central unit transmitter having an input to receive downstream digital data, and having an input for receiving a master clock signal and an input for receiving a master carrier signal, said transmitter transmitting signals from which said master clock and master carrier signals can be recovered and from which said downstream data can be recovered;

a transmission media coupled to said modulator through which signals from said central transmitter propagate;

a remote unit receiver coupled to said transmission media to receive said signals transmitted from said central unit transmitter and having a local clock reference input for receiving a local clock reference signal and a local carrier reference input for receiving a local carrier reference signal, said remote unit received for recovering and outputting said downstream data;

a tracking loop circuit in said remote unit receiver and coupled to said local clock reference input and said local carrier reference input and having a frame detector coupled to a first voltage controlled oscillator for supplying to said remote unit receiver said local clock reference signal and having a slicer coupled to a second voltage controlled oscillator for supplying said local carrier reference signal, said tracking loop circuit for locking the phase and frequency of said local clock reference signal and said local carrier reference signal to the phase and frequency of said master clock and master carrier signals from said signals transmitted by said central unit transmitter;

a remote unit transmitter coupled to said transmission media and having an input for upstream digital data and having an input coupled to receive a carrier reference signal which is phase coherent with said local master carrier reference signal and having an input coupled to receive a carrier reference signal which is phase coherent with said local clock reference signal, said remote unit transmitter, for transmitting signals from which said clock and carrier

reference signals can be detected and for transmitting signals from which said upstream digital data can be extracted;

a central unit receiver coupled to said transmission media and having inputs for receiving a phase adjusted clock signal and a phase adjusted carrier signal, said central unit receiver recovering and outputting said upstream digital data;

a phase detect and adjust circuit coupled to receive said master clock and master carrier signals and said signals transmitted from said remote unit transmitter, for supplying a phase adjusted master clock signal and a phase adjusted master carrier signal to said central unit receiver, and occasionally or periodically adjusting the phase of said phase adjusted master carrier signal and said phase adjusted master clock signal to be phase coherent with the local master carrier reference signal and the local master clock reference signal, respectively, used by said remote unit transmitter to transmit said upstream digital data.

2. A process of bidirectionally communicating digital data comprising:

using a master clock signal to modulate downstream digital data onto a master carrier signal, and transmitting signals through a transmission media from which said downstream digital data and said master clock signal and said master carrier signal can be recovered;

receiving said signals propagating through said transmission media, and recovering said master carrier and master clock signals and using said master carrier and master clock signals to generate local master clock reference and local master carrier reference signals which are phase coherent with said recovered master clock signal and said recovered master carrier signals, respectively, and using said local master clock reference and local master carrier reference signals to recover said downstream digital data;

using said local master clock reference and local master carrier reference signals to modulate upstream digital data onto said local master carrier reference signal, and transmitting through said transmission media signals from which said

local master clock reference signal and said local master carrier reference signal can be recovered and transmitting signals from which said upstream digital data can be recovered;

receiving said signals bearing said local master clock reference and said local master carrier reference signal information and bearing said upstream digital data information, and receiving said master clock signal and said master carrier signal and occasionally or periodically adjusting the phase or frequency or both of said master clock signal and said master carrier signal so as to be phase coherent with said local master clock reference signal and said local master carrier reference signal, respectively, to generate a phase adjusted master clock signal and a phase adjusted master carrier signal, and using said phase adjusted master clock signal and said phase adjusted master carrier signal to recover said upstream digital data.

3. A system comprising:

a central unit transceiver which uses a master clock signal and master carrier signal to transmit downstream payload data;

a plurality of remote unit transceivers each coupled to said central unit transceiver through a transmission media, and each having a receiver section including a tracking loop to recover said master clock signal and a tracking loop to recovers said master carrier signal from signals transmitted from said central unit transceiver, and including circuitry to use said recovered master clock signal, as signals generated therefrom, and said recovered master carrier signal, or signals generated therefrom, to recover said downstream payload data and to transmit upstream payload data, each said remote unit transceiver including circuitry to transmit preamble data preceding upstream payload data for use by said central unit transceiver;

and wherein said central unit transceiver includes circuitry for using said preamble data for determining the phase difference for the particular remote unit transceiver which transmitted said preamble data between the master clock signal of the central unit transceiver and that remote unit transceiver's recovered master clock signal, or signals generated therefrom, and between the master carrier signal of the central unit transceiver and the remote unit transceivers recovered master carrier signal, or signals generated therefrom, and for using the phase difference(s) so

determined for each remote unit and a rotational amplifier and circuitry associated therewith to get the proper phase adjustment factor for a particular remote unit applied to said rotational amplifier when payload data from that particular remote unit transceiver is being received so as to recover said upstream payload data transmitted by that particular remote unit transceiver thereby eliminating the need for tracking loops in said central unit transceiver to continuously track the clock and carrier signals used by each said remote unit transceiver to transmit upstream payload data.

4. A process comprising:

transmitting downstream payload data from a central unit modem using a master clock and master carrier;

recovering said master clock and master carrier signals in each of a plurality of remote unit modems physically spread throughout a distributed system and using said recovered master clock and master carrier or signals generated therefrom and phase coherent therewith to recover downstream data in each remote unit modem, and using said recovered master clock and master carrier, as signals generated therefrom and phase coherent therewith, to transmit upstream data preceded by preamble data;

using said preamble data from each particular remote unit modem in said central unit modem to determine the phase difference between said central unit modem master clock and the clock signal used by that particular remote unit modem to transmit upstream data and to determine the phase difference between said central unit modem master carrier and the carrier of that particular remote unit modem to transmit upstream data; and

using the phase differences so determined for each particular remote unit modem to recover in said central unit modem the upstream payload data transmitted by that particular remote unit modem.

5. A central unit modem apparatus comprising:

a framing circuit having a memory and circuitry to receive downstream data and store it in said memory organized as frames of data each frame comprising one or more symbols, and having circuitry to read data out of said memory and present said downstream data at an output;

a transmitter coupled to receive said downstream data from said output and having circuitry to multiplex said downstream data onto a transmission media using any form of multiplexing and any form of modulation; and

a synchronous code division multiplexed receiver coupled to receive modulated upstream signals from a plurality of remote unit modems and having circuitry to demodulate and demultiplex said upstream signals and detect upstream data from said demodulated, demultiplexed upstream signals.

6. The apparatus of claim 5 wherein said transmitter includes circuitry to transmit downstream information defining the phase and frequency of a master clock signal and a master carrier signal, and wherein said upstream signals include signals therein which define the phase and frequency of clock and carrier signals used in said remote unit modems to generate said upstream signals, and wherein said synchronous code division multiplexed receiver includes tracking loop circuitry to track the phase and frequency of the clock and carrier signals used by each remote unit modem and generate clock and carrier signals locked in phase and frequency to the clock and carrier signals used in said remote unit modem to generate said upstream signals, and circuitry to use said generated clock and carrier signals to demodulate and demultiplex said upstream signals and detect said upstream data from said demodulated, demultiplexed upstream signals.

7. The apparatus of claim 5 wherein said transmitter includes circuitry to transmit downstream information defining the phase and frequency of a master clock signal and a master carrier signal, and wherein said upstream signals include signals therein which define the phase and frequency of the clock and carrier signals used by said remote unit modems to generate said upstream signals wherein said clock and carrier signals used in said remote unit modems to generate said upstream signals are locked in phase and frequency with or are at least phase coherent with, master clock and master carrier signals recovered from said downstream information transmitted by central unit transmitter and wherein said upstream signals include preamble data transmitted by each remote unit modem prior to transmission by that remote unit modem of any upstream payload data, and wherein said synchronous code division multiplexed receiver include circuitry to use said preamble data from each remote unit modem to determine the phase differences for that particular remote unit modem between the master clock and master carrier signals at said central unit modem and the clock and carrier signals

used by that particular remote unit modem as received at said central unit modem, and for storing said phase differences in memory for use with said central unit modem master clock and master carrier signals in demodulating, demultiplexing said upstream signals and detecting upstream data therein, said circuitry for occasionally updating said phase differences for each particular remote unit modem when said particular remote unit modem again transmits preamble data.

8. A remote unit modem comprising:

a receiver circuit capable of demodulating and demultiplexing downstream signals transmitted from a central unit modem regardless of the type of modulation and multiplexing used by said central unit modem, and detecting and recovering downstream payload data from said demodulated, demultiplexed downstream signals, and wherein said downstream signals include information from which can be recovered a master clock and master carrier signal used by said central unit modem in generating said downstream signals, and wherein said receiver circuit further comprises circuitry to recover from said downstream signals said master clock and master carrier signals and generate remote unit clock and carrier signals therefrom which are locked in phase and frequency with said recovered master clock and master carrier signals, and using said remote unit clock and carrier signals so generated to demodulate and demultiplex said downstream signals and to detect said downstream payload data from the demodulated, demultiplexed downstream signals, said receiver including circuitry to detect a marker signal transmitted from said central unit modem which marks a fixed reference time in each frame of downstream data transmitted by said central unit modem and to generate a signal indicating when said marker signal arrives, said receiver including circuitry to receive management and control data from said central unit even before frame synchronization is achieved;

a synchronous code division multiplexed transmitter coupled to receive said remote unit clock and carrier signals, or clock and carrier signals which are at least phase coherent with said remote unit clock and carrier signals, and coupled to receive upstream payload data, said synchronous code division multiplexed transmitter including ranging circuitry for achieving frame synchronization by transmitting ranging signals with good correlation properties which can be found easily in noise and can be found even if they arrive in the middle of payload data, said ranging circuitry for transmitting said ranging signals at a series of different trial and error delays relative to said fixed

reference time in each frame of data transmitted by said central unit modem, the amount of said delays established by a time delay input signal, said synchronous code division multiplexed transmitter including multiplexing and modulation circuitry for code division multiplexing said upstream payload data to generate spread spectrum data and modulating the resulting spread spectrum data onto one or more RF carriers for transmission to said central unit modem; and

a computer coupled to said receiver to receive said management and control data and coupled to receive said signal indicating when said marker signal arrived from said central unit modem, and including circuitry programmed to generate said time delay input signal to control said trial and error delays used by said transmitter to transmit said ranging signal and programmed to transmit said time delay input signal to said synchronous code division multiplexed transmitter and programmed to vary the amount of delay commanded by said time delay input signal relative to the time of receipt of said marker signal and controlling the amount of power used to transmit said ranging signals until said management and control data received from said central unit modem indicate that a delay value T_d and a power level has been found which causes said ranging signals to arrive within gaps in the central unit frames thereby achieving approximate frame boundary alignment, and, thereafter, for holding the amount of delay T_d commanded by said time delay input signal constant at the amount of delay which caused said approximate frame boundary alignment.

9. The apparatus of claim 8 wherein said ranging circuitry and computer are structured to peform boundless ranging in a system having a maximum total turnaround time of X frames by performing the following steps:

(1) transmitting a Barker code upon every receipt of every marker signal received from said central unit, each such Barker code transmission done a predetermined delay T_d after receipt of said marker signal, said computer programmed to start said transmissions at a first power level and a first delay value and to increase said delay but leave the power level the same until all of a predetermined number of delays have been tried, and then to repeat the process of incrementing the delays at a new higher power level, and continue increasing the power level and trying all of said predetermined delays until a message is received from said central unit that a Barker code has been detected in a gap in said central unit frames;

(2) once said message has been received from said central unit that a Barker code has been detected in a gap, determining which delay value caused said Barker code to arrive during said gap by setting the delay to the value used X frames before said message was received, and sending a single Barker code transmission, and waiting at least X frames for a reply message from said central unit that a Barker code was received during said gap;

(3) if no reply message is received during the interval waited by the remote unit modem, incrementing the T_d delay value to the value used to transmit the Barker code in the frame which followed the frame corresponding to the value for T_d selected in step 2, and waiting for X frames for a reply, and continuing this process of incrementing the value of T_d until a first reply message is received from the central unit naming a first central unit frame number in which a Barker code was detected and requesting the remote unit to send it ID code, and holding the value of T_d steady at the value which resulted in said reply message requesting sending of said ID code;

(4) transmitting an ID code comprising a start bit which is always a 1 and a predetermined number of ID bits a predetermined number of which are 1s and the rest of which are 0s, with a 1 being defined as the transmission of a Barker code in a gap and a 0 defined as the lack of transmission of a Barker code in a gap;

(5) receiving a second reply message from said central unit when said central unit receives said start bit and said ID code and detects therein a predetermined number of 1s indicative of the fact that no other remote unit's ID code arrived at the same time at the central unit, said second reply message containing at least the ID code detected by the central unit and the central unit frame number during which said start bit arrived, said ranging circuitry and said computer structured to compare the ID code in said second reply message against the ID code transmitted by said remote unit, and, if there is a match, calculating a frame offset number comprised of the frame number given in said second reply message minus the frame number given in said first reply message,

(6) and, thereafter controlling said synchronous code division multiplexed transmitter in said remote unit to transmit each numbered frame to the central unit delayed by a predetermined interval following receipt of a marker signal identifying a particular central unit frame number, said predetermined interval

being equal to the time duration of one frame times said offset number plus the value of T_d.

10. A remote unit modem comprising:

a receiver circuit capable of demodulating and demultiplexing downstream signals transmitted from a central unit modem regardless of the type of modulation and multiplexing used by said central unit modem, and detecting and recovering downstream payload data from said demodulated, demultiplexed downstream signals, and wherein said downstream signals include information from which can be recovered a master clock and master carrier signal used by said central unit modem in generating said downstream signals, and wherein said receiver circuit further comprises circuitry to recover from said downstream signals said master clock and master carrier signals and generate remote unit clock and carrier signals therefrom which are locked in phase and frequency with said recovered master clock and master carrier signals, and using said remote unit clock and carrier signals so generated to demodulate and demultiplex said downstream signals and to detect said downstream payload data from the demodulated, demultiplexed downstream signals, said receiver including frame detector circuitry to detect a Barker code transmitted from said central unit modem during each gap between frames of downstream data transmitted by said central unit, said Barker code marking the position of each said gap in said stream of downstream data, said frame detector generating a marker signal indicating when said barker code arrives, said receiver including circuitry to receive management and control data from said central unit;

a synchronous code division multiplexed transmitter coupled to receive said remote unit clock and carrier signals, or clock and carrier signals which are at least phase coherent with said remote unit clock and carrier signals, and coupled to receive upstream payload data, said synchronous code division multiplexed transmitter including ranging circuitry for achieving exact frame synchronization by transmitting Barker codes back to said central unit at a series of different trial and error delays T_d relative to receipt of said marker signal, the amount of said delays T_d being controlled by a time delay input signal, said synchronous code division multiplexed transmitter including multiplexing and modulation circuitry for using said remote unit clock and carrier signals or said clock and carrier signals which are at least phase coherent with said remote unit clock and carrier signals to code division multiplex said upstream payload data to generate spread spectrum data and to modulate the resulting spread spectrum data

onto one or more RF carriers for transmission as modulated RF signals to said central unit modem, said synchronous code division multiplexed transmitter transmitting said modulated RF signals in frames, each frame transmitted at an interval following occurrence of said marker signal, said interval defined by the value of T_d which causes each said frame to arrive with its frame boundaries exactly aligned in time with receive frame boundaries of said central unit; and

a computer coupled to said receiver to receive said management and control data and said marker signal, and including circuitry programmed to generate and increment said time delay input signal to control said trial and error delays T_d used by said transmitter to transmit said Barker code, said time delay input signal being coupled to said synchronous code division multiplexed transmitter, said computer also programmed to vary the amount of delay commanded by said time delay input signal relative to the time of receipt of said marker signal until said management and control data received from said central unit modem indicate that a delay value T_d has been found which causes said Barker codes transmitted by said transmitter to arrive within gaps in central unit frames, said computer programmed to further fine tune the value of said time delay input signals until said Barker codes transmitted by said remote unit arrive exactly in the middle of gaps in said central unit frames thereby achieving exact frame boundary alignment with central unit frame boundaries.

11. The apparatus of claim 10 wherein said Barker code transmitted by said central unit has encoded therein information defining the phase of a master clock signal used in said central unit, and wherein said frame detector includes early-late gating circuitry which generates a clock steering signal from which said remote unit master clock signal can be generated using a phase lock loop in the remote unit.

12. The apparatus of claim 11 wherein said receiver includes a synthesizer which generates said remote unit master carrier signal from either said remote unit master clock signal or from said clock steering signal.

13. The apparatus of claim 10 wherein said receiver includes a synthesizer, a slicer, a voltage controlled oscillator and a control loop including a loop filter for generating said remote unit master carrier signal from BPSK modulated pilot channel data which includes the phase information of the master carrier signal in said central unit, said

slicer generating a phase error signal by comparing the phase of the BPSK pilot channel data actually received to what the phase should have been for pilot channel data modulated using the master carrier and transmitted without latency and without channel impairments, said phase error signal coupled to said voltage controlled oscillator through said control loop to phase lock the phase of a carrier reference signal generated by said voltage controlle oscillator to the phase of the master carrier at the central unit, said carrier reference signal coupled to said synthesizer for controlling the phase of said remote unit master carrier signal generated thereby.

14. The apparatus of claim 10 wherein each frame transmitted by said central unit has a number and is followed by a gap, and wherein said remote unit modem is intended for use in a distributed system having a plurality of other remote unit modems, and wherein said synchronous code division multiplexed transmitter always uses the same orthogonal spreading code or codes from the total set of orthogonal spreading codes used to spread the spectrum of the upstream data, and wherein said ranging circuitry and said computer combine to alter the value of said transmit frame timing delay T_d so as to exactly center the Barker code transmitted by said synchronous code division multiplexed transmitter in a gap in a central unit frame which may or may not be the same gap other remote unit synchronous code division multiplexed transmitters have centered their Barker codes within, wherein each gap is associated with a particular numbered frame at the central unit.

15. A remote unit modem for use in a distributed system comprised of a plurality of remote unit modems coupled by a shared transmission media to a central unit modem, comprising:

a receiver circuit capable of demodulating and demultiplexing downstream signals transmitted from a central unit modem regardless of the type of modulation and multiplexing used by said central unit modem, and detecting and recovering downstream payload data from said demodulated, demultiplexed downstream signals, and wherein said downstream signals include information from which can be recovered a master clock and master carrier signal used by said central unit modem in generating said downstream signals, and wherein said receiver circuit further comprises circuitry to recover from said downstream signals said master clock and master carrier signals and generate remote unit clock and carrier signals therefrom which are locked in phase and frequency

with said recovered master clock and master carrier signals, and using said remote unit clock and carrier signals so generated to demodulate and demultiplex said downstream signals and to detect said downstream payload data from the demodulated, demultiplexed downstream signals, said receiver including frame detector circuitry to detect a Barker code transmitted from said central unit modem during each gap between frames of downstream data transmitted by said central unit, said Barker code marking the position of each said gap in said stream of downstream data, said frame detector generating a marker signal indicating when said barker code arrives, said receiver including circuitry to receive management and control data from said central unit;

a synchronous code division multiplexed transmitter coupled to receive said remote unit clock and carrier signals, or clock and carrier signals which are at least phase coherent with said remote unit clock and carrier signals, and coupled to receive upstream payload data, said synchronous code division multiplexed transmitter including boundless ranging circuitry for achieving exact frame synchronization by transmitting Barker codes back to said central unit at a series of different trial and error delays T_d relative to receipt of said marker signal, the amount of said delays T_d being controlled by a time delay input signal, said synchronous code division multiplexed transmitter including multiplexing and modulation circuitry for using said remote unit clock and carrier signals or said clock and carrier signals which are at least phase coherent with said remote unit clock and carrier signals to code division multiplex said upstream payload data to generate spread spectrum data and to modulate the resulting spread spectrum data onto one or more RF carriers for transmission as modulated RF signals to said central unit modem, said synchronous code division multiplexed transmitter transmitting said modulated RF signals in frames, each frame transmitted at an interval following occurrence of said marker signal, said interval defined by the value of T_d which causes each said frame to arrive with its frame boundaries approximately aligned in time with receive frame boundaries of said central unit; and

a computer coupled to said receiver to receive said management and control data and said marker signal, and including circuitry programmed to generate and increment said time delay input signal to control said trial and error delays T_d used by said transmitter to transmit said Barker code, said time delay input signal being coupled to said synchronous code division multiplexed transmitter, said receiver and ranging circuitry being structured in each remote unit and said computer so programmed in each

said remote unit so as to cooperate with said receiver and said ranging circuitry in said transmitter of each said remote unit modem to function in a way to carry out the following process to achieve approximate frame synchronization and rough power alignment:

(1) transmitting a Barker code a predetermined delay T_d following the occurrence of every marker signal, said computer programmed to start said Barker code transmissions at a first power level and at a first minimum value for delay T_d and to increase said delay every frame and re-transmit another Barker code while leaving the power level the same until a maximum value for delay T_d is reached, and then to repeat the process of incrementing the value of the delay T_d at a new higher power level than the power level used during the previous cycle, and continue increasing the power level and trying all of said predetermined delays at that power level until a first command and control message is received from said central unit indicating that a possible Barker code has been detected in a gap in said central unit frames;

(2) once said first message has been received from said central unit that a possible Barker code has been detected in a gap, said computer assumes the activity detected was one of the prior Barker code transmissions from this remote unit, and determines which delay value T_d of the multiple values for T_d previously used to send Barker codes caused a Barker code from this remote unit to arrive during a central unit gap by setting the delay T_d to the value used X frames before said first message was received where X is equal to the total turnaround time in whole frames to the farthest remote unit in the distributed system, sending a single Barker code transmission using that delay value, and waiting at least X frames for a second reply message from said central unit indicating that a Barker code was received during a central unit receive frame gap;

(3) if no second reply message is received during said X frames, incrementing the value for delay T_d in said computer to the value used to transmit the Barker code in the X + 1 frame which is defined as the frame which followed the frame corresponding to the value for T_d selected in step 2 and sending said incremented delay value to said ranging circuitry to cause it to transmit another

Barker code at a time following receipt of the next marker signal by an interval equal to said incremented delay value, and waiting the duration of X frames for said second reply message, and continuing this process of incrementing the value of T_d to each of the values used at each of the X preceding frames, transmitting a single Barker code and waiting X frames for receipt of said second reply message until said second reply message is received from the central unit indicating activity has been detected in a gap and naming a first central unit frame number having a gap in which a Barker code was detected and requesting the remote unit to send the ID code for that remote unit, and holding the value of delay T_d steady at the value which resulted in transmission of said second reply message;

(4) using said ranging circuitry at the request of said computer to transmit an ID code comprising a start bit which is always a 1 and a predetermined number of ID bits a predetermined number of which are 1s and the rest of which are 0s, with a 1 being defined as the transmission of a Barker code in a gap and a 0 defined as the lack of transmission of a Barker code in a gap;

(5) receiving a third reply message from said central unit when said central unit receives said start bit and said ID code and detects therein a predetermined number of 1s indicative of the fact that no other remote unit's ID code arrived at the same time at the central unit thereby indicating no contention, said third reply message containing at least the ID code detected by the central unit and the central unit frame number during which said start bit of said ID code arrived, said ranging circuitry and said computer structured and programmed to compare the ID code in said third reply message against the ID code transmitted by said remote unit modem, and, if there is a match, to calculate a frame offset number needed to achieve boundless ranging, said frame offset number being comprised of the frame number given in said third reply message minus the frame number given in said second reply message; and

(6) thereafter receiving command and control messages assigning particular orthogonal spreading codes to be used during particular central unit receive frame numbers and counting marker signals to generate a count indicating the central unit frame number just received and subtracting said offset number therefrom to generate a new frame count and controlling said synchronous code division multiplexed transmitter in said remote unit to transmit each numbered frame to the central unit delayed by the current value for the delay T_d when said

new frame count reaches a frame number authorized for transmission by said central unit and using the orthogonal spreading codes assigned by said central unit to code division multiplex the data to be transmitted during said assigned frame number.

16. The apparatus of claim 15 wherein said receiver, ranging circuitry and computer of each said remote unit modem are structured to carry out the following further functions to implement a fine tuning process to achieve exact centering of the Barker code from each remote unit modem in the center of the gap following the same central unit frame number:

(1) waiting for a fourth reply message from said central unit indicating fine tuning is to be performed by that particular remote unit modem and adjusting the value of delay T_d and transmitting a Barker code and waiting for a fine tuning feedback message from said central unit and continuing to adjust the value of the delay T_d until a message is received indicating that said Barker code has arrived in the center of a listening window in a gap of a central unit frame.

17. The apparatus of claim 16 wherein said receiver, ranging circuitry and computer of each said remote unit modem are structured to carry out the following further functions to implement a contention resolution process such that multiple remote unit modems can all perform ranging simultaneously:

(1) receiving a message from said central unit containing the previous ID code sent by the remote unit modem and requesting transmission of another ID code, and responding thereto by transmitting another randomly selected ID code having a start bit which is a 1 and a predetermined number of 1s in an ID code having a predetermined number of bits in a like number of consecutive frames;

(2) waiting for a message from said central unit containing the new ID code just sent, and, if said message is received, stopping the ranging process, but if a message is received from said central unit indicating that a contention has been detected, performing a contention resolution process of deciding whether to continue ranging with a predetermined probability of continuing to perform the ranging process.

18. A process for fine tuning the amount of power with which data is transmitted to a central unit receiver by each of a plurality of remote unit transmitters which are physically spread throughout a distributed digital data communication system, using code division multiple access multiplexing accomplished with orthogonal, cyclic spreading codes for transmissions, each said remote unit transmitter having a variable gain amplifier, and wherein said central unit has a receiver having an adaptive gain control circuit comprised of a slicer and an amplifier having a variable gain the gain control factor of which is controlled by an amplitude correction factor stored in memory, said memory storing an amplitude correction factor for each said spreading code and a control circuit that receives slicer amplitude error signals from said slicer and controls the gain number applied to said amplifier, comprising the following steps performed one at a time in each remote unit transmitter:

(1) transmitting training data from a remote unit transmitter to said central unit receiver using a gain level of one in said remote unit transmitter variable gain amplifier, the spectrum of said training data having been spread using each of a plurality of consecutive, orthogonal, cyclic spreading codes, and modulating the training data using BPSK modulation;

(2) setting the gain of said variable gain amplifier using the amplitude correction factor for a particular one of the codes in the midst of said consecutive, orthogonal, cyclic spreading codes, and allowing said adaptive gain control circuit to converge on an amplitude correction factor for the training data that results in proper decisions on said training data made by said slicer and adjusting the gain of said variable gain amplifier to a new gain value in accordance with said amplitude correction factor so determined;

(3) transmitting said new gain value to said remote unit transmitter and setting the power level of transmissions by said remote unit transmitter in accordance with said new gain value; and

(4) setting the gain control factor of said variable gain amplifier in said central unit to one.

19. A process for fine tuning the amount of power with which data is transmitted to a central unit receiver by each of a plurality of remote unit transmitters which are physically spread throughout a distributed digital data communication system, using code division multiple access multiplexing accomplished with orthogonal, cyclic spreading

codes for transmissions, and wherein said central unit has a receiver having an symbol equalizer having at least an FFE digital adaptive filter having a main tap and one or more side taps, comprising the following steps performed one at a time in each remote unit transmitter:

(1) setting an adaptation coefficient in said symbol equalizer to a value selected to insure rapid convergence;

(2) transmitting training data from a remote unit transmitter to said central unit receiver the spectrum of said training data having been spread using each of a plurality of consecutive, orthogonal, cyclic spreading codes, and modulating the training data using BPSK modulation;

(3) disabling said one or more side taps and enabling said symbol equalizer filter to converge for an interval sufficient to train said main tap adequately for purposes of power alignment;

(4) calculating the amplitude of the main tap correction factor after said interval has elapsed and comparing said amplitude the expected amplitude of said main tap when proper power alignment has been achieved and calculating the difference and comparing said difference or said difference divided by a constant to a threshold;

(5) if said threshold is exceeded, transmitting a new gain value to said remote unit transmitter, said new gain value being equal to said difference times a constant and setting the power level of transmissions by said remote unit transmitter in accordance with said new gain value; and

(4) repeating steps 1 through 5 until said difference is less than said threshold or a predetermined number of iteratins of steps 1 through 5 has been exceeded.

20. A digital data communication apparatus including frame synchronization fine tuning circuitry, comprising:

a central unit transceiver having a transmitter which transmits downstream data in CU downstream frames separated by gaps using master clock and master carrier signals which are both synthesized from a single crystal oscillator source and which transmits a marker signal during every CU downstream frame gap, said marker signal bearing at least phase information defining the phase of said master clock, said central unit transceiver also having

a receiver which receives upstream data in CU upstream frames separated by gaps;

a remote unit transceiver having a transmitter which transmits said upstream data in RU upstream frames separated by gaps, said RU upstream frames and gaps having the same duration as said CU upstream frames and gaps to said central unit receiver and including ranging circuitry which transmits a ranging signal to achieve frame synchronization so as to exactly align said RU upstream frame boundaries with said CU upstream frame boundaries, said remote unit transceiver having a receiver circuitry to receive said marker signal and command and control messages transmitted in said CU downstream frames, said ranging signal transmitted during the process of achieving frame synchronization during selected RU upstream frames at a delay T_d following receipt of said marker signal, said remote unit receiver including synchronization circuitry to recover said master clock and master carrier signals from said marker signal, a correlator to correlate said received downstream signals against a signal having the shape and duration of said marker signal so as to locate said marker signal so as to generate a correlation peak when said marker signal is found and said CU downstream frame gap is located thereby, and having early-late gating circuitry to sample said correlation peak at two different points on either side of the maximum amplitude of said correlation peak to generate a clock steering signal during each CU downstream frame and having clock tracking loop circuitry to generate a local master clock signal from said clock steering signal, and having synthesizer circuitry to generate a local master carrier signal from phase information in said local master clock signal, said remote unit transmitter using said local master clock and local master carrier signals or signals that are phase coherent therewith to transmit said RU upstream frames, and including circuitry to transmit, at predetermined times, preamble data before transmitting said RU upstream frames, said preamble data being such that said central unit receiver can determine phase and amplitude error correction factors therefrom so that said central unit receiver can recover said local master clock and local master carrier signals used by said remote unit transmitter and to properly demodulate and detect data in said RU upstream frames, said correction factors being made necessary by latency and channel impairments, said remote unit transmitter including circuitry to alter said delay T_d by trial and error for different

transmissions of said ranging signal, and wherein said remote unit receiver includes circuitry to receive command and control messages from said central unit transmitter regarding changing the value of said delay T_d, and changing the value of delay T_d in accordance therewith;

and wherein said central unit receiver includes ranging circuitry, including correlation circuitry structured so as to find said ranging signals, and including circuitry to compare the position of said ranging signals to the centers of said CU upstream frame gaps and generate messages for transmission to said remote unit to cause said delay T_d to be altered until said ranging signals arrive exactly in the center of CU upstream frame gaps so as to exactly align said RU upstream frame boundaries with said CU upstream frame boundaries, and further including circuitry to receive said preamble data from each remote unit and derive therefrom amplitude and phase error correction factors to aid in the process of recovering digital data transmitted in said RU upstream frames.

21. The apparatus of claim 20 wherein said CU receiver correlation circuitry includes circuitry to correlate received upstream signals against a signal having the same shape and duration as said ranging signal to generate a correlation peak and to perform a course time alignment to get said ranging signal within a predtermined distance from the center of said CU upstream frame gaps and further comprises circuitry to perform fine tuning centering by performing early-late gating sampling on said correlation peak and determine the difference between said early and late samples and average a plurality of said differences to average out any random noise content, and to use the sign of the averaged differences to generate steering commands to send to said remote unit to cause alteration of said delay T_d, said ranging circuitry repeating the steps described herein until said ranging signals are aligned exactly in the center of said CU upstream frame gap.

22. The apparatus of claim 21 wherein a plurality of said remote unit transceivers are physically spread throughout a distributed communication system, and wherein said central unit downstream and upstream frame boundaries are coincident in time and have the same frame numbers, and wherein said ranging signal is a Barker code, and wherein

each of said plurality of remote unit transceivers and said central unit transceiver include circuitry to perform boundless ranging by performing the following functions:

(1) transmitting from said remote unit transmitter a Barker code a predetermined delay T_d following the receipt by said remote unit receiver of every marker signal during the ranging process to achieve frame synchronization, said ranging circuitry of said remote unit transmitter structured to start said Barker code transmissions at a first power level and at a first minimum value for delay T_d and to increase said delay every RU upstream frame and re-transmit another Barker code while leaving the power level the same until a maximum value for delay T_d is reached, and then to repeat the process of incrementing the value of the delay T_d at a new higher power level than the power level used during the previous cycle of delay incrementations, and continue increasing the power level and trying all of said predetermined delays T_d at that power level until a first command and control message is received from said central unit transceiver indicating that a possible Barker code has been detected in a gap in said central unit frames;

(2) once said first message has been received from said central unit that a possible Barker code has been detected in a gap, said remote unit transmitter ranging circuitry being structured to assume that the activity detected was one of the prior Barker code transmissions from this remote unit transceiver, said remote unit transmitter ranging circuitry structured to then determine which delay value T_d of the multiple values for T_d previously used to send Barker codes caused a Barker code from this remote unit to arrive during a central unit gap, said determination being made by setting the delay T_d to the value used X frames before said first message was received where X is equal to the total turnaround time in whole frames to the farthest remote unit transceiver in said distributed system, sending a single Barker code transmission using that delay value, and waiting at least X frames for a second reply message from said central unit transceiver indicating that a Barker code was received during a central unit upstream frame gap;

(3) if no second reply message is received during said X frames, said remote unit transmitter ranging circuitry is structured to increment the value

for delay T_d to the value used to transmit the Barker code in the X + 1 frame, where the X + 1 frame is is defined as the frame which followed the frame corresponding to the value for T_d selected in step 2, said remote unit ranging circuitry being structured to use said incremented delay value to transmit the next said ranging signal and wait an interval of X frames for said second reply message, said remote unit ranging circuitry structured to continue this process of incrementing the value of T_d to each of the values used at each of the X preceding frames, transmitting a single Barker code and waiting X frames for receipt of said second reply message until said second reply message is received by said remote unit receiver from the central unit transceiver indicating activity has been detected in a central unit frame gap and indicating the central unit frame number having the gap in which a Barker code was detected, said second reply message resulting in a signal being passed to said remote unit ranging circuitry requesting same to transmit an ID code for that remote unit, and holding the value of delay T_d steady at the value which resulted in a Barker code transmission arriving in a gap in a central unit upstream frame;

(4) said remote unit ranging circuitry structured to respond to said second reply message by transmitting an ID code comprising a start bit which is always a 1 and a predetermined number of ID bits a predetermined number of which are 1s and the rest of which are 0s, with a 1 being defined as the transmission of a Barker code in a gap and a 0 defined as the lack of transmission of a Barker code in a gap;

(5) receiving a third reply message in said remote unit receiver generated by said central unit transceiver when said central unit transceiver receives said start bit and said ID code and detects therein a predetermined number of 1s indicative of the fact that no other remote unit's ID code arrived at the same time at the central unit thereby indicating no contention between different remote unit transceivers, said third reply message containing at least the ID code detected by the central unit transceiver and the central unit frame number during which said start bit of said ID code arrived, said ranging circuitry structured to compare the ID code in said third reply message against the ID code transmitted by said remote unit transceiver, and, if there is a match, to calculate a frame offset number needed to achieve boundless ranging, said frame offset

number being comprised of the frame number given in said third reply message minus the frame number given in said second reply message; and

(6) said central unit transceiver structured to generate and transmit to each said remote unit transceiver command and control channel assignment messages assigning particular orthogonal spreading codes, timeslots, frequencies or other channel multiplexing attributes to be used by said remote unit transceiver during particular central unit frame numbers, said remote unit transceiver including circuitry structured to count marker signals received from said central unit transceiver to generate a count indicating the current central unit frame number and subtract said offset number therefrom to generate an upstream transmit frame count, said remote unit transmitter including circuitry to receive said channel assignment message information from said remote unit receiver and to used said upstream transmit frame count and the current value for delay T_d to transmit each numbered frame of upstream data to the central unit transceiver using the assigned channel when said upstream transmit frame count reaches a frame number authorized for transmission by this remote unit transceiver by said central unit transceiver.

23. The apparatus of claim 22 wherein said central unit transceiver and said remote unit transceiver each further comprise means for performing equalization training so as to predistort transmissions to minimize the effect on the detection process of phase and amplitude errors induced by channel impairments.

24. The apparatus of claim 20 wherein said remote unit transmitter includes a precode equalization filter in the form of a digital FFE filter having multiple coefficients, and wherein said remote unit transceiver includes circuitry for receiving comand and control communications from said central unit transceiver instructing changes in the value of said delay T_d and for multiplying the coefficients of said FFE filter in said remote unit transmitter by the negative of the phase shift at said central unit transceiver of signals received from this remote unit transceiver which will be caused by the change in the delay T_d at said remote unit transceiver for subsequent transmissions so as to provide phase shift compensation.

25. The apparatus of claim 21 wherein said remote unit transmitter includes a precode equalization filter in the form of a digital FFE filter having multiple coefficients, and wherein said remote unit transceiver includes circuitry for receiving comand and control communications from said central unit transceiver instructing changes in the value of said delay T_d and for multiplying the coefficients of said FFE filter in said remote unit transmitter by the negative of the phase shift at said central unit transceiver of signals received from this remote unit transceiver which will be caused by the change in the delay T_d at said remote unit transceiver for subsequent transmissions so as to provide phase shift compensation.

26. The apparatus of claim 22 wherein said remote unit transmitter includes a precode equalization filter in the form of a digital FFE filter having multiple coefficients, and wherein said remote unit transceiver includes circuitry for receiving comand and control communications from said central unit transceiver instructing changes in the value of said delay T_d and for multiplying the coefficients of said FFE filter in said remote unit transmitter by the negative of the phase shift at said central unit transceiver of signals received from this remote unit transceiver which will be caused by the change in the delay T_d at said remote unit transceiver for subsequent transmissions so as to provide phase shift compensation.

27. The apparatus of claim 23 wherein said remote unit transmitter includes a precode equalization filter in the form of a digital FFE filter having multiple coefficients, and wherein said remote unit transceiver includes circuitry for receiving comand and control communications from said central unit transceiver instructing changes in the value of said delay T_d and for multiplying the coefficients of said FFE filter in said remote unit transmitter by the negative of the phase shift at said central unit transceiver of signals received from this remote unit transceiver which will be caused by the change in the delay T_d at said remote unit transceiver for subsequent transmissions so as to provide phase shift compensation.

28. A bidirectional digital data communication system including a central unit transceiver having circuitry for accepting downstream data from multiple sources organized into a time division multiplexed stream of data and assembling symbol data

therefrom, and including multiplexer and modulator circuits for code division multiplexing said downstream symbol data and modulating the resulting multiplexed data onto one or more RF carriers and transmitting the resulting downstream RF signals on a shared media and including a plurality of remote unit transceivers including demodulating and demultiplexing circuitry to demodulate said downstream signals and demultiplex the resulting demodulated signals and including deframer circuitry for receiving the resulting demultiplexed data and reassembling a time division multiplexed stream of data therefrom, said remote unit transceivers including circuitry to receive upstream data from multiple sources in time division multiplexed streams and assemble upstream symbols therefrom, and including multiplexing and modulator circuitry to code division multiplex said upstream symbol data and modulate the resulting multiplexed data onto one or more RF carriers and transmit the resulting upstream RF signals on said shared media using frequency division multiple access to separate the upstream RF signals from the downstream RF signals, said central unit transceiver including demodulator and demultiplexing circuitry to demodulate and demultiplex the upstream RF siganls and including deframer circuitry to receive the demultiplexed upstream data and reassemble a time division multiplexed data stream therefrom.

29. A distributed communication system having a central unit transceiver coupled by a shared transmission media to a plurality of remote unit transceivers wherein said remote unit transceivers and said central unit transceiver include circuitry to bidirectionally communicate digital data using any form of multiplexing and any form of modulation using a single master clock and a single master carrier, both said master clock and said master carrier being synthesized in said central unit transceiver from a single crystal controlled oscillator, said master clock and master carrier signals being transmitted downstream to said remote units and recovered there and used by each remote unit transceiver to transmit data upstream to said central unit, each said remote unit transmitting its upstream data after transmitting at least some preamble data, said central unit transceiver including circuitry to use said preamble data from each remote unit transceiver to determine amplitude and phase correction factors for use in receiving data from said remote unit transceiver by correcting for phase and amplitude errors caused by channel impairments and the transmission delay between said remote unit transceiver and said central unit transceiver.

30. A distributed communication system having a central unit transceiver coupled by a shared transmission media to a plurality of remote unit transceivers wherein said remote unit transceivers and said central unit transceiver include circuitry to bidirectionally communicate digital data in synchronized frames separated by gaps using any form of multiplexing and any form of modulation wherein each said remote unit transceiver and said central unit transceiver include ranging circuitry to carry out a ranging process before upstream data is transmitted whereby each said remote unit transceiver receives a marker signal from said central unit transceiver and transmits ranging signals at different values of a delay T_d following receipt of said marker signal until a delay T_d is found which causes the ranging signals to arrive at said central unit transceiver exactly in the middle of a gap between central unit transceiver frames such that frame boundaries of frames transmitted by each said remote unit transceiver arrive exactly aligned in time with frame boundaries of said central unit frames.

31. A distributed communication system having a central unit transceiver coupled by a shared transmission media to a plurality of remote unit transceivers wherein said remote unit transceivers and said central unit transceiver include circuitry to bidirectionally communicate digital data in synchronized frames separated by gaps using any form of multiplexing and any form of modulation wherein each said remote unit transceiver and said central unit transceiver include ranging circuitry to carry out a ranging process before upstream data is transmitted whereby each said remote unit transceiver receives a marker signal from said central unit transceiver and transmits ranging signals at different values of a delay T_d following receipt of said marker signal until a delay T_d is found which causes the ranging signals to arrive at said central unit transceiver exactly in the middle of a gap between central unit transceiver frames such that frame boundaries of frames transmitted by each said remote unit transceiver arrive exactly aligned in time with frame boundaries of said central unit frames, and wherein said central unit transceiver transmits said said marker signals and data in downstream frames using a single master clock and a single master carrier, both said master clock and said master carrier being synthesized in said central unit transceiver from a single crystal controlled oscillator, said master clock and master carrier signals being transmitted downstream to said remote units in any known fashion and recovered there and used by each remote unit transceiver to transmit data upstream to said central unit

in frames, each said remote unit transceiver transmitting its upstream data after transmitting at least some preamble data, said central unit transceiver including circuitry to use said preamble data from each remote unit transceiver to determine amplitude and phase correction factors for use in conjunction with said master clock and master carrier signals generated in said central unit transceiver to receive data from said remote unit transceiver by correcting for phase and amplitude errors caused by channel impairments and the transmission delay between said remote unit transceiver and said central unit transceiver thereby eliminating the need for continuous tracking loops in said central unit transceiver to recover the clock and carrier signals used by said remote unit to transmit upstream data.

32. The apparatus of claim 30 wherein at least said remote unit transceivers use code division multiplexing as the form of multiplexing to keep data from different sources separate.

33. The apparatus of claim 30 wherein at least said remote unit transceivers use time division multiple access as the form of multiplexing to keep data from different sources separate.

34. The apparatus of claim 30 wherein at least said remote unit transceivers use inverse Fourier as the form of multiplexing to keep data from different sources separate.

35. The apparatus of claim 30 wherein at least said remote unit transceivers use digital multitone as the form of multiplexing to keep data from different sources separate.

36. The apparatus of claim 30 wherein at least said remote unit transceivers use frequency division multiple access as the form of multiplexing to keep data from different sources separate.

37. The apparatus of claim 31 wherein at least said remote unit transceivers use code division multiplexing as the form of multiplexing to keep data from different sources separate.

38. The apparatus of claim 31 wherein at least said remote unit transceivers use time division multiple access as the form of multiplexing to keep data from different sources separate.

39. The apparatus of claim 31 wherein at least said remote unit transceivers use inverse Fourier as the form of multiplexing to keep data from different sources separate.

40. The apparatus of claim 31 wherein at least said remote unit transceivers use digital multitone as the form of multiplexing to keep data from different sources separate.

41. The apparatus of claim 31 wherein at least said remote unit transceivers use frequency division multiple access as the form of multiplexing to keep data from different sources separate.

42. A digital data communication system having a plurality of transceivers bidirectionally communicating digital data wherein said transceivers transmitting data in at least one direction use code division multiple access multiplexing to keep different conversations separate, where conversation is defined as transmission of data from one source or computer process to another different source or computer process via at least two transceivers, and wherein said transceivers include means for transmitting data in frames and in a frame synchronous manner such that frames of data from physically distributed transceivers all arrive at a predetermined location with their frame boundaries aligned in time.

43. The apparatus of claim 42 further comprising means coupled to each transceiver which uses code division multiple access multiplexing, for pseudorandomly changing the spreading codes used during designated frames for transmission of each conversation.

44. The apparatus of claim 42 wherein said transceivers include means for receiving incoming data in timeslots of a TDMA stream, breaking the data from each timeslot into smaller groups of bits, Trellis encoding each group of bits to add a predetermined number of redundant bits in a normal mode and a larger number of redundant bits in a fallback mode when channel impairments require more redundant bits, and interleaving the Trellis encoded groups of bits over one or more frames, generating a plurality of

symbols from said interleaved groups of bits, spreading the spectrum of said symbols and modulating the resulting digital data into the radio frequency spectrum using carrierless modulation and orthogonal bandpass filters to limit the bandwidth of each of real and imaginary components to a predetermined bandwidth, said bandpass filters having transfer functions one of which is the Hilbert transform of the other.

45. The apparatus of claim 44 wherein each transceiver includes means for demodulating, demultiplexing and detecting the signals output from the demultiplexing process with a slicer, rotational amplifier and symbol equalizer to generate preliminary decision data and then Viterbi decoding the output data from said slicer in a Viterbi decoder, and using the output data from said Viterbi decoding process to reassemble the original TDMA stream.

46. The apparatus of claim 42 wherein said transceivers using code division multiple access multiplexing use orthogonal spreading codes, and wherein one of said transceivers is a central unit transceiver having a bandwidth allocation means therein for receiving requests for bandwith from said remote unit transceivers, making decisions regarding how to allocate limited bandwidth to said remote unit transceivers based upon any of a plurality of different sets of dynamic bandwidth allocation rules including but not limited to reservation, first-come, first-served, first-come, first-served with bandwidth guarantees to selected transceivers and for transmitting bandwidth allocation decisions to transceivers in downstream messages, and wherein the other transceivers are remote unit transceivers each having means therein to cooperate to implement the bandwidth allocation scheme in use by receiving bandwidth allocation messages assigning specific codes to use during specific frames, and using said codes to spread the spectrum of data to be transmitted to said central unit transceiver during the specified frames.

47. A digital data communication system having a plurality of transceivers bidirectionally communicating digital data between a central unit transceiver and a plurality of distributed remote unit transceivers, and wherein at least said remote unit transceivers transmit data to said central unit transceiver using code division multiple access multiplexing to keep conversations between different remote unit transceivers and said central unit transceiver separate, where conversation is defined as transmission of data from one source or computer process to another different source or

computer process via at least two transceivers, and wherein said central unit transceiver transmits data downstream to said remote unit transceivers in frames separated by gaps, and wherein said remote unit transceivers include ranging means for transmitting data in upstream frames in a frame synchronous manner such that upstream frames of data from physically distributed transceivers all arrive at said central unit transceiver with their frame boundaries exactly aligned in time, and wherein each remote unit transceiver uses permanently assigned orthogonal spreading codes.

48. The apparatus of claim 47 further comprising equalization means in said transceivers for cooperating to determine separate equalization coefficients for digital filters in each said remote unit transceiver to correct for channel impairments that signals from that remote unit transceiver will suffer in propagating to said central unit transceiver.

49. A digital data communication system having a plurality of transceivers bidirectionally communicating digital data between a central unit transceiver and a plurality of distributed remote unit transceivers, and wherein at least said remote unit transceivers transmit data to said central unit transceiver using code division multiple access multiplexing to keep conversations between different remote unit transceivers and said central unit transceiver separate, where conversation is defined as transmission of data from one source or computer process to another different source or computer process via at least two transceivers, and wherein said central unit transceiver transmits data downstream to said remote unit transceivers in numbered frames separated by gaps, and wherein each remote unit transceiver uses temporarily assigned cyclic, orthogonal time shared spreading codes during specific frame numbers for transmission to said central unit transceiver after receiving assignments of specific codes to use during specific frames from said central unit transceiver, and wherein each said remote unit transceiver includes boundless ranging means for transmitting data in upstream frames in a frame synchronous manner such that all upstream frames of data transmitted from physically distributed transceivers at different delays after receipt of any particular frame number from the central unit transceiver and having the spectra thereof spread with codes assigned to said remote unit transceivers for use during a specific central unit transceiver frame number arrive at said central unit transceiver

with their frame boundaries exactly aligned in time with the boundaries of the central unit frame having said specific frame number.

50. The apparatus of claim 49 further comprising equalization means in said central unit and remote unit transceivers for cooperating to determine separate equalization coefficients for digital filters in each said remote unit transceiver and said central unit transceiver to correct for amplitude and phase errors caused by channel impairments that affect signals propagating from that remote unit transceiver to said central unit transceiver.

51. The apparatus of claim 50 further comprising power alignment means in said remote unit transceivers and said central unit transceiver for cooperating to fine tune the power level of transmissions from said remote unit transceivers to said central unit transceiver such that all transmissions arrive at approximately the same power level.

52. The apparatus of claim 51 further comprising equalization means in said central unit and remote unit transceivers for cooperating to determine separate equalization coefficients for digital filters in said remote unit transceiver and said central unit transceiver to correct for amplitude and phase errors caused by channel impairments that affect signals propagating from that central unit transceiver to each said remote unit transceiver.

53. A digital data communication system having a plurality of transceivers bidirectionally communicating digital data between a central unit transceiver and a plurality of distributed remote unit transceivers, and wherein at least said remote unit transceivers transmit data to said central unit transceiver using code division multiple access multiplexing to keep conversations between different remote unit transceivers and said central unit transceiver separate, where conversation is defined as transmission of data from one source or computer process to another different source or computer process via at least two transceivers, and wherein said central unit transceiver transmits data downstream to said remote unit transceivers in frames separated by gaps, and wherein said remote unit transceivers include ranging means for transmitting data in upstream frames in a frame synchronous manner such that upstream frames of data from physically distributed transceivers all arrive at said

central unit transceiver with their frame boundaries exactly aligned in time to a same central unit frame, all remote unit transceivers having their frame boundaries aligned in time with the frame boundaries of the same central unit frame, and wherein each remote unit transceiver uses temporarily assigned orthogonal spreading codes.

54. The apparatus of claim 53 wherein a predetermined number of spreading codes are reserved as access channels for upstream requests from remote unit transceivers to the central unit transceiver for bandwidth allocation, and further comprising media access control means in said central unit transceiver and said remote unit transceivers for sharing said access channels with all remote unit transceivers to send bandwidth allocation messages to said central unit transceiver, resolve contentions between different remote unit transceivers for use of the same access channel, receive bandwidth allocation messages and use the assigned codes for transmissions to said central unit transceiver.

55. A process for media access control in a CDMA digital data communication system having a first plurality of access channels and a second, much larger plurality of payload data channels and having a plurality of remote unit transceivers which transmit data to a central unit transceiver using spreading codes assigned by said central unit transceiver, comprising:

sending a seed number to all said remote unit transceivers;

each remote unit transceiver needing to send a bandwidth request message then uses said seed number to pseudorandomly select one of said access channels to use to send said bandwidth request message;

each remote unit transceiver needing to send a bandwidth request message then uses said seed number to pseudorandomly select a first plurality of symbols of a superframe comprised of a second, larger plurality of symbols to send as a bandwidth request message;

listening on all access channels in said central unit transceiver to determine if more than said first plurality of symbols was received, indicating a contention between two or more remote unit transceivers for the same access channel;

if a contention is detected, sending a contention detected message downstream indicating a contention of a particular access channel to all remote unit transceivers;

in each remote unit transceiver attempting to send a bandwidth request message on that access channel, receiving said contention detected message and making a decision as to whether to continue requesting access with a 50% probability of continuing to request access;

if no contention is detected, broadcasting a message to all remote unit transceivers identifying which first plurality of symbols was received indicating to the remote unit transceiver which transmitted said first plurality of symbols that it now has sole control of said access channel for bandwidth request message traffic.

56. A process for bandwidth allocation in a CDMA digital data communication system having a plurality of payload data channels and having a plurality of remote unit transceivers which transmit data to a central unit transceiver using spreading codes assigned by said central unit transceiver, each spreading code representing one payload data channel and wherein the number of said remote unit transceivers exceeds the number of spreading codes, comprising:

receiving bandwidth allocation requests from a plurality of remote unit transceivers;

deciding in said central unit transceiver how to allocate the available bandwidth based upon the current allocation method selected from a plurality of different allocation methods;

sending messages to said remote unit transceivers indicating which codes have been assigned to them; and

when conditions warrant changing from the current allocation method to a different allocation method, changing the current allocation method to said different allocation method and thereafter making bandwidth allocation decisions based upon said different allocation method.

57. A distributed communication system having a central unit transceiver coupled by a shared transmission media to a plurality of remote unit transceivers wherein said remote unit transceivers and said central unit transceiver include circuitry to

bidirectionally communicate digital data in synchronized frames separated by gaps using any form of multiplexing and any form of modulation, and wherein said central unit transceiver transmits data to said remote unit transceivers in downstream frames using a single master clock and a single master carrier, both said master clock and said master carrier being synthesized in said central unit transceiver from a single crystal controlled oscillator, and wherein said central unit transceiver transmits a Barker code signal to all remote unit transceivers during every gap between a central unit transceiver frame, said Barker code having encoded therein master clock and master carrier phase informaton, and wherein each said remote unit transceiver recovers said master clock from said Barker code and uses said master clock signal to phase lock a local clock signal and uses said phase information in said Barker code to synthesize a local carrier signal in phase lock with said master carrier and uses said local clock and local carrier signals to transmit data upstream to said central unit transceiver.

58. A method of clock recovery in a CDMA system using cylic, orthogonal spreading codes, comprising:

detecting the amount of crosstalk between adjacent channels spread by neighboring cyclic spreading codes;

using the amount of crosstalk to generate a clock steering signal to alter the phase of a local clock oscillator to match the phase of a clock oscillator used to generate the clock used to transmit said adjacent channels.

59. A method of clock recovery in a distributed digital data communication system having a central unit transceiver and a plurality of physically distributed remote unit transceivers, comprising:

transmitting preamble data preceding payload data each time a remote unit transceiver transitions from an inactive state to an active state;

using said preamble data in said central unit transceiver to determine phase and amplitude error correction factors for the remote unit transceiver which transmitted said preamble data;

using said amplitude and phase correction factors for each remote unit transceiver to receive payload data from said remote unit transceiver.

60. A method for transmitting multiple channels of digital data simultaneously over a cable television media carrying cable television programming, comprising:

receiving multiple channels of digital data;

selecting portions of said digital data from each channel and organizing said portions as an information vector having n elements;

performing code division multiplexing by performing a matrix multiplication of said information vector times a code matrix comprised of n orthogonal spreading codes, each code comprising one row or one column of said code matrix and having n elements, said matrix multiplication generating a result vector having n elements, each element comprised of the sum of the partial products of multiplication of each of the n elements of said information vector times the n elements of one of said orthogonal spreading codes;

modulating the n elements of said result vector onto one or more radio frequency carriers and transmitting the resulting radio frequency carriers on a cable television media carrying cable television programming while limiting the overall bandwidth of the resulting radio frequency signals so as to not interfere with said cable television programming.

61. The process of claim 60 wherein the step of modulating the n elements of said result vector onto one or more radio frequency carriers comprises the step of dividing each of said n elements of said result vector into an inphase and a quadrature part, and modulating the amplitude of a first radio frequency carrier during successive times using the inphase parts of each of said n elements of said result vector, and modulating the amplitude of a second radio frequency carrier during the same successive times using the quadrature parts of each of said n elements of said result vector, said second radio frequency carrier having the same frequency as said first radio frequency carrier but differing in phase by 90 degrees, and summing the two resulting radio frequency carriers and placing the summed signal on said cable television media.

62. The process of claim 60 wherein the step of performing code division multiplexing includes the steps of changing the particular orthogonal code each element of each new information vector is multiplied by while calculating said partial products which are summed to generate the individual elements of each new result vector.

63 The process of claim 60 wherein the step of frequently changing the orthogonal codes the elements of each new information vector are multiplied by to generate said partial products which are summed to generate each element of said result vector includes the steps of pseudorandomly selecting the particular orthogonal code each new information vector is multiplied by to generate the partial products which are summed to generate each element of each new result vector.

64. A method for transmitting to a central unit multiple channels of digital data generated by a plurality of sources coupled to a plurality of physically distributed remote units which are coupled to said central unit via a cable television media designed to carry radio frequency signals, said multiple channels of digital data being transmitted simultaneously over said cable television media as a plurality of frames of digital data, said cable television media also carrying frequency division multiplexed cable television programming, comprising:

establishing frame synchronization at each remote unit by determining a transmit frame timing reference for each said remote unit such that, when each remote unit transmits data using that remote unit's transmit frame timing reference, said data will arrive at said central unit simultaneously;

receiving one or more channels of digital data at each remote unit;

at each remote unit, constructing an information vector by selecting portions of said digital data from each channel of digital data received at said remote unit and organizing said portions as selected elements of said information vector having n elements where each element of said information vector corresponds to one of said channels but wherein any element of said information vector corresponding to a channel from which no data is received by any particular remote unit is set to zero;

at each remote unit, performing code division multiplexing by performing a matrix multiplication of the information vector generated at said remote unit times a code matrix comprised of n orthogonal spreading codes, each code comprising one row or one column of said code matrix and having n elements, said matrix multiplication generating a result vector having n elements, each element of said result vector comprised of the sum of the partial products of multiplication of each of the n elements of said information vector times the n

elements of one of said orthogonal spreading codes, and wherein zero elements of said information vector cause zero elements in said result vector;

at each remote unit, after frame synchronization has been achieved by that remote unit, modulating the n elements of said result vector onto one or more radio frequency carriers;

summing the one or more radio frequency carriers generated by each remote unit with one or more radio frequency carriers generated by other remote units and transmitting the resulting radio frequency carriers on a cable television media carrying cable television programming while limiting the overall bandwidth of the resulting radio frequency signals so as to not interfere with said cable television programming.

65. The process of claim 64 wherein said channels of digital data received by each remote unit are received in the form of a time division multiplexed data stream comprised of a plurality of timeslots wherein each timeslot contains one or more data bits from one channel such that all channels have a timeslot into which data from that channel may be tranmitted in said time division multiplexed data stream to a remote unit.

66. The process of claim 65 wherein said step of constructing said information vector comprises the steps of storing a portion of the bits from each timeslot as a corresponding element of said information vector, and wherein each said frame of data transmitted from each remote unit to said central unit comprises transmission of data generated from a sufficient number of code division multiplexed information vectors so as to code division spread all data from all timeslots to be transmitted during a single frame.

67. The process of claim 66 wherein each timeslot contains 9 bits, 8 of which are data from any source external to said remote unit and the 9th bit of which is available to send miscellaneous command and control information from the remote unit to said central unit, and wherein data from three information vectors are code division multiplexed from each remote unit to said central unit during each frame, and wherein each information vector is constructed at a remote unit by placing 3 bits from each timeslot containing data received at a remote unit into an element of said information vector, and

repeating this process for each of said three information vectors constructed during each frame so as to transmit all 9 bits from each timeslot containing data during a frame.

68. A method for transmitting multiple channels of digital data over a transmission media simultaneously with transmissions carrying other services in a distributed communication system comprised of at least one central unit modem coupled by said transmission media to a plurality of remote unit modems, comprising:

receiving multiple channels of digital data;

in each of said central unit modem and said remote unit modems composing frames of data for transmission by selecting portions of said digital data from each channel received by said modem and organizing said portions as an information vector having n elements with at least one information vector per frame;

in at least said remote unit modems, performing code division multiplexing by performing a matrix multiplication of said information vector times a code matrix comprised of n orthogonal spreading codes, each channel having data therein having at least one code assigned thereto, each code comprising one row or one column of said code matrix and having n elements, said matrix multiplication generating a result vector having n elements;

using the n elements of the result vectors that comprise one frame of data in said remote unit modems or, in said central unit modems, using the n elements of the result vectors that define one frame of data if code division multiplexing is performed or, if code division multiplexing is not performed in said central unit modem, using the n elements of the information vectors that define one frame of data in said central unit modem to create the information content in one or more radio frequency carriers and transmitting the resulting radio frequency carriers carrying the data from each remote unit frame on said transmission media toward said central unit modem (hereafter referred to as the upstream channel), and transmitting the resulting radio frequency carriers carrying the data from each central unit frame on said transmission media toward said remote unit modems (hereafter referred to as the downstream channel), while limiting the overall bandwidth of the resulting radio frequency carriers transmitted in each direction so as to not interfere with said other services being simultaneously transmitted on said transmission media;

and wherein said step of composing frames of data in said central and remote unit modems further comprises the steps of composing equal sized frames of data in each of said central unit and remote unit modems, and wherein said step of transmitting the resulting radio frequency carriers carrying the data from each remote unit frame on said transmission media toward said central unit modem further comprises the step of waiting for a selected transmit frame timing delay for each remote unit before transmitting a frame from that remote unit, and further comprising the step of performing a ranging process to determine for each said remote unit modem a suitable transmit frame timing delay value which will cause frames transmitted from that remote unit modem to arrive at said central unit modem with frame boundaries aligned in time with the frame boundaries of said central unit modem frames;

and further comprising the step of, prior to transmission of any frames of data in the upstream direction from a remote unit modem, performing a training process for the remote unit modem by performing the following steps following the conclusion of said ranging process for said remote unit modem:

checking the accuracy of the frame synchronization established by said ranging process in each remote unit modem by using a predetermined one of a plurality of neighboring, orthogonal, cyclic spreading codes to send training data to said central unit modem from each remote unit modem, one remote unit modem at a time, and correlating said received data against each of said predetermined number of orthogonal, cyclic spreading codes in said central unit modem to determine how much crosstalk into neighboring cyclic spreading codes exists, and, if crosstalk exists for any remote unit modem, adjusting said transmit frame timing delay for said remote unit modem and rechecking the accuracy of said frame synchronization using the new transmit frame timing delay value, and, if an acceptably small level of crosstalk exists, proceeding to the next step;

setting the power level of transmissions from said remote unit modem such that said training sequence data transmitted by said remote unit modem is detected by said central unit modem with an acceptably low error rate and at approximately the same power level as transmissions from all the other remote unit modems;

performing upstream equalization by sending training sequence data to said central unit modem from said remote unit modem using each of a plurality of different, neighboring orthogonal, cyclic spreading codes;

adjusting tap weight coefficients of one or more adaptive equalizer circuits in a receiver in said central unit modem to minimize detection errors and reiterating for a plurality of iterations the process of sending said training sequence data to said central unit modem using each of a plurality of different, neighboring orthogonal spreading codes to spread the spectrum of the data and again adjusting the tap weight coefficients of said adaptive equalizer in said central unit modem to minimize errors, and when detection errors have been minimized after a plurality of iterations, sending the final tap weight coefficients for use as the tap weight coefficients for an adaptive precode filter in said remote unit transmitter and setting the tap weight coefficients of said adaptive equalizer in said receiver of said central unit modem to one; and

performing downstream equalization by sending training sequence data to said remote unit modem from said central unit modem using each of a plurality of different, neighboring orthogonal spreading codes;

adjusting tap weight coefficients of a first adaptive equalizer circuits in a receiver in said remote unit modem to minimize detection errors and reiterating for a p[illegible] iterations the process of sending said training sequence data from said central unit modem to [illegible] unit modem using each of a plurality of different, neighboring orthogonal spreading codes to spread the spectrum of the data and again adjusting the tap weight coefficients of said first adaptive equalizer in said remote unit modem to minimize errors, and when detection errors have been minimized after a plurality of iterations, sending the final tap weight coefficients for use as the tap weight coefficients for a second adaptive equalizer in said receiver of said remote unit modem and setting the tap weight coefficients of said first adaptive equalizer in said receiver of said remote unit modem to initialization values.

69. The method of claim 68 wherein each remote unit and central unit frame includes a gap during which no payload data is sent, and wherein said step of performing a ranging process comprises the steps of:

1) transmitting a barker code signal from said central unit modem to said remote unit modems during the gap in each central unit frame transmitted downstream;

2) in each remote unit modem, performing said step of detecting when each central unit frame arrives by detecting said barker code signal transmitted by said central unit modem to establish a receive frame timing reference indicating when a central unit frame has arrived;

3) in each remote unit modem which is performing said ranging process, setting a trial and error value for said transmit frame timing delay value, and imposing said transmit frame timing delay between the time of arrival of said barker code signal from said central unit modem at said remote unit modem and transmission of an RU ranging signal back toward said central unit modem from said remote unit modem, said transmission of said RU ranging signal occurring during a gap in an RU frame of said remote unit which is transmitting said remote unit ranging signal, said RU ranging signal being common to all remote unit modems;

4) in said central unit modem, monitoring each central unit frame gap for the receipt of RU ranging signal, and generating a management and control data message for transmission to said remote unit modems indicating whether any RU ranging signal was received during a central unit frame gap;

5) in each remote unit modem which is performing said ranging process, receiving said management and control message and determining whether an RU ranging signal arrived at said central unit modem during a central unit frame gap, and, if not, setting a new value for said transmit frame timing delay and repeating steps 1) through 5);

6) repeating steps 1) through 6) until said RU ranging signal arrives during a central unit frame gap, and generating and transmitting to said remote units a management and control message indicating that at least one RU ranging signal arrived at said central unit modem in a gap in a central unit frame and requesting all remote unit modems which are performing ranging to send their authentication sequences;

7) transmitting from each remote unit which has transmitted an RU ranging pulse an authentication sequence comprised of transmission of m/2 RU ranging signals uniquely spread amoung m RU frame gaps where m is an even number;

8) monitoring said central unit frame gaps to determine if more than m/2 RU ranging signals arrived during m central unit frames following said request to send authentication sequences;

9) if only m/2 RU ranging signals arrived, identifying said remote unit modem which transmitted said m/2 ranging signals by examining the sequence of said m/2 RU ranging signals within the m central unit frame gaps within which they arrived and transmitting an ID management and control message indicating the identity so determined;

10) in each remote unit modem which is performing said ranging process, examining said management and control message to determine if said remote unit modem's identity is in said management and control message;

11) fine tuning said transmit frame timing delay of said remote unit modem the identity of which is included in said ID management and control message so that said RU ranging signals transmitted by said remote unit modem arrive in the center of said central unit frame gaps;

12) if in step 8 said central unit modem determines that more than m/2 RU ranging signals arrived, generating and transmitting to all remote units a management and control message requesting all remote unit modems which are carrying out said ranging process to execute collision resolution processes;

13) in each remote unit modem executing said collision resolution protocol, executing a random yes/no decision regarding whether to continue said ranging process;

14) retransmitting from each remote unit modem which has decided to continue said ranging process the authentication sequence unique to said remote unit modem;

15) monitoring said central unit frame gaps to determine if more than m/2 RU ranging signals arrived during central unit frame gaps that span the authentication sequence frames transmitted by the remote unit modems which are still ranging;

16) if more than m/2 ranging signals are found, generating and transmitting to said remote unit modems a management and control message so indicating and repeating steps 13) through 15) until only m/2 RU ranging signals are found in central unit frame gaps spanning said authentication sequence interval or no RU ranging signals are found in said central unit frame gaps spanning said authentication sequence interval;

17) if in step 15) or 16) only m/2 RU ranging signals are found in said central unit frame gaps spanning said authentication sequence interval, identifying the remote unit modem having its RU ranging signals in the central unit frame gaps spanning said authentication sequence interval and fine tuning the transmit frame timing delay thereof so that said RU ranging signals arrive in the centers of said central unit frame gaps;

18) if in step 15) or 16) no RU ranging signals are found in said central unit frame gaps spanning said authentication sequence interval, generating and transmitting a management and control message to all remote unit modems that were performing said ranging process to re-execution their collision resolution processes;

19) in all remote unit modems that were performing said ranging process and said central unit modem, repeating steps 13) through 19) until only m/2 RU ranging signals are found in the central unit frame gaps spanning said authentication sequence interval, or more than a predetermined number of iterations through steps 13) through 19) have been performed;

20) if more than said predetermined number of iterations through steps 13) through 19) have been performed, repeating steps 1) through 20) until only one remote unit modem's authentication sequence is found in the central unit frame gaps, and that remote unit's transmit frame timing delay has been fined tuned;

21) repeating steps 1) through 20) until all remote unit modems which need to perform said ranging process have successfully concluded said ranging process and have had their transmit frame timing delays fine tuned.

70. A bidirectional digital data communication system having a central unit transceiver coupled by a transmission media to a plurality of distributed remote unit transceivers wherein said central unit transceiver includes a transmitter having an encoder for

receiving data and encoding it into frame for multiplexing, a multiplexer for multiplexing the encoding data to generate multiplexed data and a modulator for using said multiplexed data to modulate one or more RF carriers so as to send downstream data to said remote unit transceivers wherein said multiplexer uses any form of multiplexing to keep data directed to different remote units separate, and wherein each said remote unit transceiver sends upstream data to said central unit transciever using synchronous time division multiple access multiplexing using an encoder to receive upstream data and divide it into groups suitable for transmission in timeslots of an upstream frame, said upstream frame being of the same size as said downstream frames, and a time division multiple access multiplexer for receiving said smaller groups of data from said encoder and placing said groups of data into timeslots in an upstream frame assigned to this remote unit transceiver and a modulator to receive the TDMA multiplexed data and modulate it onto one or more RF carriers, each said remote unit transceiver including a frame detector circuit to recognize a marker signal in each downstream frame to establish a receive frame timing reference, and a ranging circuit for cooperating with said central unit transceiver and said frame detector circuit to establish a delay T_d relative to said receive frame timing reference for each frame and for transmitting each said upstream frame at a time T_d after receipt of said marker signal marking receipt of a downstream frame, said ranging circuit in each remote unit transceiver cooperating with said central unit transceiver to establish the value for T_d in each remote unit transceiver at a value which will cause all upstream frames from all remote unit transceivers to arrive at said central unit transceiver having their frame boundaries exactly aligned in time with the frame boundaries of said central unit frames.

71. An apparatus for transmitting multiple channels of digital data encoding supplemental services from a remote unit to a central unit over a shared transmission media using synchronous code division multiple access transmission, comprising:

means for accepting incoming data of a time division multiple access stream comprised of N time slots or channels each of which contains one or more bits of digital data encoding said supplemental services and organizing the data of said N channels into a frame comprised of M contiguous information vectors from each of which a symbol for transmission will be generated and a guardband during which no data from said time divsion multiple access stream is transmitted, said reorganizing carried out by reorganizing a portion of the data from each of said N channels into elements of each of

said M information vectors each comprised of N elements, each element comprising a subgroup of bits from one channel or timeslot of said time divsion multiple access stream plus error detection and correction bits generated by a Trellis encoder, each information vector containing at least one element from each said channel plus error detection and corrections bits, and for dividing each element of each said information vector into a real and imaginary component;

means for direct sequence spread spectrum encoding of each of said M information vectors using N orthogonal, cyclic codes by matrix multiplying both the real and imaginary components of each information vector times a matrix embodying said N orthogonal, cyclic codes such that the data from each channel is multiplied by an orthogonal, cyclic spreading code assigned to that channel so as to generate M result vectors, each result vector being the basis for one symbol, each result vector having N elements, each element of each result vector having real and imaginary components and passing the data of said real and imaginary result vectors for each frame through shaping passband filters having transfer functions which satisfy the Nyquist criteria and which are orthogonal to each other in the frequency domain by a Hilbert transform relationship and which have bandwidths which limit the resulting intermediate frequency signals exiting said filters to a predetermined bandwidth and for summing the resulting data encoding intermediate frequency signals to generate M symbols for transmission, and converting the data encoding said M symbols into an analog signal of said intermediate frequency and for converting said intermediate frequency signal encoding said M symbols to a radio frequency signal which will not interfere with other services being carried on said transmission media, the resulting radio frequency signal being M-ary QAM modulated, and for transmitting said modulated radio frequency carrier signals over said shared transmission media said composition of said information vectors and said encoding of said information vectors using orthogonal codes being such that the temporal relationships of the data bits in said time divsion multiple access stream is altered in said symbols, and such that when modulated radio frequency carrier is transmitted over said shared transmission media, the energy distribution of the signals resulting from said data from said N channels is spread out over substantially all of said frame and all of the bandwidth of the band of frequencies devoted to said supplemental services; and

means for adjusting the timing of said transmission of each frame from said remote unit to said central unit such that each transmitted frame arrives at said central unit aligned in time with frame boundaries of frames of said central unit.

72. A head end modem for providing multiple-user, multiple-source simultaneous digital communication over a limited bandwidth with one or more remote unit modems in a distributed systems linked by a transmission medium, comprising:

a framing/addressing/packetizing circuit for receiving payload data bytes and organizing said payload data into frames and organizing said payload data such that information as to which remote unit modem and peripheral each payload data byte is directed can be determined;

a master clock for generating a master clock signal;

a master carrier local oscillator for generating one or more carrier signals which will be modulated with digital data to be transmitted;

a transmitter for receiving said data from said framing/addressing/packetizing circuit and said master clock signal and said one or more carrier signals and using said data to modulate said one or more carrier signals using any modulation process which can also transmit said master clock reference signal and said carrier signals to said remote unit modems for use there for synchronization including synchronization to said frame boundaries, said transmitter coupled to said transmission media so as to output said one or more modulated carrier signals as downstream radio frequency signals; and

an SCDMA receiver coupled to receive upstream RF signals with digital data by said remote unit modems and coupled to said master clock and said master carrier local oscillator to receive said master clock signal and said master clock local oscillator, said SCDMA receiver functioning to synchronously extract payload data from said upstream RF signals by performing the inverse code transformation of a code transformation which was performed by an SCDMA transmitter in a remote unit modem which modulated said upstream RF signals by spreading the spectrum thereof using orthogonal, pseudorandom spreading codes assigned to that modem, said inverse code transformation performed on signals received from a particular remote unit modem using the same orthogonal spreading codes used by said remote unit modem, said extracted payload data being presented at an output;

a gap monitor circuit coupled to said SCDMA receiver for aiding the process of achieving frame synchronization by said remote unit modesm by monitoring an interval during each frame for the presence of unique codes

transmitted by said remote unit modems and for generating status data indicating how many codes have been received during said interval;

a circuit for receiving said status data from said gap monitor circuit and generating suitable management and control data needed by the remote units to achieve frame synchronization such that all frames of like number transmitted by the various remote unit modems arrive at said central unit modem at the same time; and

a data transfer circuit for receiving said management and control data and causing said transmitter to transmit same during an interval dedicated to transmission of said management and control data.

73. A remote unit modem for providing multiple-user, multiple-source simultaneous digital communication over a limited bandwidth with a central unit modem in a distributed system linked by a transmission medium, comprising:

a receiver coupled to receive downstream radio frequency signals organized into frames from said central unit, said receiver functioning to synchronously extract payload data for use by peripheral devices or processes coupled to said remote unit modem and synchronously extract any management and control data transmitted by the CU to said said remote unit modem to achieve frame synchronization or in support of other management function, and further functioning to recover master clock and carrier reference signals transmitted by said central unit modem, and wherein said central unit modem organizes data sent to said remote unit modem into frames each of which has a gap therein during which no payload data is sent, said central unit modem transmitting a barker code during at least one said gap, said receiver further functioning to detect when said barker code transmitted by said central unit modem during a gap is received and generating a receive frame timing reference signal establishing a receive frame timing reference as to when the frames of data transmitted by said central unit modem start, said receiver including at least a gap monitor circuit, a demodulator, a detector, and, if necessary a decoder/despreader circuit which are compatible with the central unit transmitter such that said receiver is capable of performing said extraction of payload and management and control data and detecting said barker code;

an SCDMA transmitter coupled to receive said master clock and carrier reference signals recovered by said receiver, and coupled to receive payload data from said peripheral devices or processes coupled to said remote unit modem, and coupled to receive management and control data to be transmitted to said central unit modem, said SCDMA transmitter functioning to organize said payload data and said management and control data into frames of the same size as the frames of data transmitted to said receiver by said central unit modem and to spread the Fourier spectrum of said payload data and said management and control data over a bandwidth which is much greater than the Fourier spectrum said payload data and said management and control data originally had, and further functioning to use said spread spectrum data to modulate one or more carrier signals for transmission on said transmission media, said process of organizing payload and management and control data into frames, spreading the spectrum of said data and using said spread spectrum data to modulate one or more carriers being done synchronously using said master clock and carrier reference signals recovered by said receiver, said transmitter also functioning to transmit each frame of modulated signals to said central unit to said central unit modem over said transmission media a predetermined transmit frame timing delay after a frame of data has been received from said central unit modem, as established by said receive frame timing reference signal;

a ranging generator circuit functioning to generate and send to said SCDMA transmitter data defining a barker code for transmission to said central unit modem during a ranging process;

a control circuit coupled to receive said management and control data extracted by said receiver and said receive frame timing reference signal generated by said receiver and for controlling said SCDMA transmitter to carry out a ranging process by calculating a trial and error value for said transmit frame timing delay T_d and sending T_d to said SCDMA transmitter to control the time of transmission of a barker code, said control circuit also for monitoring said management and control data to determine if the barker code arrived at said central unit modem during a gap, and for continuing to vary the value of T_d until said barker codes transmitted by said SCDMA transmitter arrive in said gap as indicated by said management and control data thereby achieving frame synchronization and thereafter holding the value of T_d steady.

74. A transmitter apparatus for simultaneously transmitting to a receiver multiple channels of digital data over a cable television media carrying cable television programming, comprising:

a framer circuit for receiving a time division multiplexed stream of data comprised of N timeslots per frame, each timeslot carrying digital data from one of N channels, said framer for storing in a memory the data from selected ones of said timeslots assigned to said transmitter, and for generating an information vector having N elements corresponding to said N timeslots, predetermined ones of said information vector elements corresponding to said selected timeslots assigned to said transmitter from which data was stored by said framer circuit, each of said predetermined elements of said information vector corresponding to timeslots assigned to said transmitter comprised of a plurality of bits which constitute a fraction of the data of one of said timeslots assigned to said transmitter;

a convolutional encoder for selectively adding one or more redundant bits to each element of said information vector to implement trellis modulation to generate a new information vector;

a code division multiplexer circuit for matrix multiplying said new information vector times a code matrix comprised of N mathematically orthogonal codes, each row comprised of an orthogonal code having N elements to generate a result vector having N elements;

a modulator for using each element of said result vector to quadrature amplitude modulate two radio frequency carriers having the same frequency but separated in phase by 90 degrees to generate inphase and quadrature RF signals, said modulation being achieved by dividing the bits of each element of said result vector into first and second parts and using the number represented by each part to define the amplitude of said inphase and quadrature RF signals, respectively, and summing said inphase and quadrature RF signals prior to transmission on said cable television media;

means for achieving frame synchronization between frames transmitted by said transmitter apparatus and the frame boundaries of frames within said receiver.

75. The apparatus of claim 74 further comprising a scrambler circuit coupled to receive elements of said information vector from said framer circuit, pseudorandomly scramble the bits of each element thereof to generate a scrambled information vector, and transmit said scrambled information vector to said convolutional encoder and wherein said convolutional encoder encodes the elements of said scrambled information vector with redundant bits.

76. The apparatus of claim 75 wherein said convolutional encoder has an idle mode wherein only zeroes are added as redundant bits, a normal mode wherein a first selected number of redundant bits are added to each element of the information vector based upon the data selected from the same timeslot of an earlier time to generate the same element of a previous information vector, and a fallback mode wherein a number of redundant bits larger than said first selected number of redundant bits are added to each element of said information vector to generate said new information vector, the mode in which said convolutional encoder operates being selectable by manipulation of a mode control signal transmitted to a mode control input of said convolutional encoder.

77. The apparatus of claim 76 further comprising code diversity means coupled to said framer circuit for controlling the order in which said information vector elements are read from said framer circuit and input to said scrambler circuit, and further comprising a buffer memory for storing said scrambled information vector, said code diversity means controlling the locations in said buffer memory in which is stored each scrambled element of said scrambled information vector.

78. The apparatus of claim 75 further comprising a precode filter coupled to receive at least said elements of said result vector and to perform an equalization process thereon to predistort said result vector elements prior to transmission to generate predistorted result vector elements and wherein said modulator uses said predistorted result vector elements to generate said inphase and quadrature RF signals such that said inphase and quadrature RF signals arrive at said receiver with substantially less distortion caused by impairments encountered in propagating along said cable television medium, said precode filter having an input for receiving a coefficient signal which controls the characteristics of the predistortion function applied to to the elements of said result vector.

79. The apparatus of claim 78 wherein said coefficient signal is set so as to establish said characteristics of said predistortion function based upon the position of the transmitter on said cable television media and the impairments then existing which will affect signals transmitted from a transmitter at that position.

80. The apparatus of claim 75 further comprising a shaping filter coupled to receive said scaled result vector elements before they are supplied to said analog to digital converter, said shaping filter having a raised cosine transfer function suitable to limit the bandwidth of the combined RF signal generated by summing said inphase and quadrature RF signals and suitable to satisfy the Nyquist criteria so as to optimize signal-to-noise ratio and minimize interference with signals from other transmitters coupled to said cable television media.

81. The apparatus of claim 75 wherein each timeslot contains 8 bits of data to which a 9th bit is added, said 9th bit encoded with predetermined nonpayload information, and wherein said framer circuit stores all 9 bits from timeslots assigned to it in memory locations in memory, and wherein data is read out from said framer circuit in frames, each frame comprised of three symbols, each symbol having N elements corresponding to the N elements of an information vector, and wherein, during each frame, said framer circuit outputs three sequential information vectors from which the three sequential symbols of the frame will be generated, the elements of each of said three sequential information vectors each corresponding to a timeslot currently assigned to said transmitter, each said element containing three of the nine bits from the corresponding assigned timeslot, said three bits hereafter called a tribit, and wherein said convolutional encoder, when operating in normal mode, adds a 4th redundant bit to each tribit to generate the elements of said new information vector prior to said matrix multiplication carried out by said code division multiplexer circuit on said new information vector.

82. The apparatus of claim 75 wherein said code division multiplexer circuit generates each of said N mathematically orthogonal codes from a cyclic code and is structured to perform said matrix multiplication by generating one orthogonal code, multiply each code element of the code so generated by a corresponding element of said new information

vector, and sum the partial products to generate an element of said result vector and then generate the next orthogonal code from the cyclic code and repeat the process to generate the next element of said result vector.

83. A system for bidirectional communication of digital data comprising:

a central unit comprising a code division multiple access transmitter and a code division multiple access transmitter;

a transmission media coupled to said central unit transmitter and receiver;

a plurality of physically distributed remote units coupled to said central unit by said transmission media, each remote unit having a code division multiple access transmitter and a code division multiple access receiver;

and wherein said central unit transmitter includes means for assigning each remote unit one or more codes from a set of orthogonal codes and wherein each said remote unit transmitter and said central unit transmitter include means for using said orthogonal codes assigned to that remote unit to encode all payload data intended for exchange between said remote unit and said central unit;

and wherein each said transmitter includes a modulator to use said digital data, after encoding using said orthogonal codes, to modulate a radio frequency carrier to generate modulated RF signals for transmission on said transmission media;

and wherein said transmitters in said central unit and said remote units are structured to transmit said modulated RF signals in frames, each frame defined as one or more symbols comprising encoded payload data and a guardband during which no payload data is transmitted, each frame separated from adjacent frames by said guardband;

and wherein central unit transmitter includes a circuit to transmit a barker code during each frame;

and wherein each remote unit transmitter includes means for carrying out a trial and error process of adjusting a transmit frame timing delay and transmitting said barker code back toward said central unit, hereafter referred to as the ranging process, and wherein each central unit receiver includes means for monitoring each guardband to determine when a barker code transmitted by a single remote unit transmitter has arrived during said guardband or if multiple

barker codes have arrived, and wherein said central unit transmitter is coupled to said central unit receiver and receives status information therefrom regarding whether a single or multiple barker codes have been received within a guardband and transmits said status information to said remote units, and wherein each remote unit receiver includes means for monitoring said status information transmitted from said central unit and for receiving information from said remote unit transmitter regarding whether said remote unit transmitter is currently carrying out said ranging process, and, when said status information received from said central unit indicates only a single barker code was received during said guardband and information from said remote unit transmitter indicates that remote unit is currently carrying out said ranging process, said remote unit receiver controls said remote unit transmitter to transmit an identification code unique to only that remote unit, and wherein said central unit receiver includes means to determine what identification code was received and to control said central unit transmitter to transmit the received identification code back to all remote units, and wherein said remote unit receivers includes means for comparing the identification code transmitted by said central unit to the identification code of said remote unit, and, if there is a match, for controlling said remote unit transmitter to set said transmit frame timing delay at the delay value which resulted in said barker code arriving at said central unit during said guardband.